

# Hydrogen Workshop

## Findings of the Utilization Break-out Group

September 19, 2000



## 3 Categories

- **Stationary Power**
- **Transportation**
- **Industrial Uses**



# Stationary Power

## TECHNOLOGIES

- **Boiler Combustion**
- **Gas Turbines**
- **Fuel Cells --- High Temp/Low Temp**
- **GT/FC Hybrids**
- **ICE Generation Sets**
- **Microturbines**
- **Hydrogen for Pollution Control**

# Stationary Power

- **Drivers**

- Carbon management
- Emissions

- **Needs**

- Combustion
- Fuel blending



Emissions reduction  
NOx and PM  
Reburning  
Lean Pre-Mix vs. DLN

- Fuel cell -- life
- Integration of power and process
- Cost reduction

# Transportation

- ICE
- Fuel Cells
- Boilers
- Turbines
- Space Shuttle
- ICE/FC Hybrid

# Transportation

- **Drivers**

- Emissions --Criterion gases
- Carbon management

- **Needs**

- Combustion
- Fuel blending
- Fuel cells
  - Power density
  - Life Fuel economy
- Impurity
- Cost reduction
- Infrastructure  
(Not just fuel)
- Systems integration
- Storage
- Safety

# Industrial

## Technologies

- Fired Heat
- DRI -- Iron Ore Reduction
- Turbines & ICES for Mechanical Power
- Upgrading Refinery Processing
- Chemical Processing

## Drivers

- Emissions and HAPs

## Needs

- Combustion/ emissions
- Systems integration



# Program Interests

- **Advance combustion of H<sub>2</sub>/HC**
  - Combustion fluid dynamics
  - Applicability to ICE, GTs, boilers
- **Impact of H<sub>2</sub> on coal combustion systems**
  - Post combustion
  - Co-firing/mixed fuels
- **Ultra-low NO<sub>x</sub> for GTs & boilers**
  - Lean pre-mix
  - Catalytic
- **Integration of H<sub>2</sub> supply with use-optimization**

# Fuel Cells

- **Component improvement**
  - Membrane electrode for PEM
- **Optimize BOP**
- **Higher temperature**
- **Materials**
- **Impurity tolerance**
- **Power conversion (efficiency, RAM, cost)**
- **Intrastructure**

# IGCC

- Advance turbine compatability
- Lean pre-mix for low NOx
- Improve RAM
- High pressure separation technologies
- Sequestration technologies
- Subsidy to cover separation and sequestration costs/risk

# Industrial Uses

- Identify small economic uses to grow infrastructure
- H<sub>2</sub> for refineries
- Mitigate FOAK costs/risk

# Time Line/Presentation

- **Find low hanging fruit**
  - Industrial uses almost economical
  - Combustion uses almost economical
  - Fleets
  - Drive to build infrastructure
- **Power from H<sub>2</sub> and Sequester CO<sub>2</sub>**
  - Commercial incentives to cover extra cost/risk
  - IGCC and Fuel Cells -- technical barriers
  - Repower/replace existing coal
- **H<sub>2</sub> Infrastructure for Transportation**
- **H<sub>2</sub> Economy - with mixture combustion and fuel cells**



